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ARBORETUM BULLETIN

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Concerning this issue . . .

Cultivate the denizens of the moisture of spring: mosses by day, slugs by night, and alders for afternoons.

Love a slug this summer! Arthur Martin leads us to understand, and possibly even to appreciate slugs. Don't miss this amusing and informative view of the traditional ghoul of the Northwest garden.

Seattle's climate being as moist as it is, we present two aspects of the mosses that flourish here. Bonnie Tucker shares some thoughts on the beauties of mosses in the garden—their cultivation rather than eradication. Visit the Japanese Garden to see these principles in action. And Arthur Jacobson describes some common and distinctive city mosses. With this primer of moss portraits one might identify mosses creeping through the lawns at home, or in the Arboretum.

The alders—sentinels of streambanks—reappear in the conclusion of Brian Mulligan's *Alders of the Arboretum*. Asiatic species are featured.

The slender look for the Arboretum Bulletin will persist through the summer issue, to appear shortly.

Enjoy the sun of summer!

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COVER

Spring's swallowtail (*Papilio rutulus*) searching for the nectar of a flower of *Iris*.

Photo: Tom Boyden

The banana slug (*Ariolimax columbianus*) in life, showing opening of the air passage to the lung (pneumostome, page 3), and the rear edge of the mantle where one would cut to dress the slug for eating (page 6). Photo: A. Martin

The Shell-less Snail

Biology and Control of Slugs

*ARTHUR W. MARTIN**

Introduction

This paper was presented at the Winter Study Weekend of the Pacific Northwest Section of the American Rock Garden Association, held in Portland, February 26, 27, and 28, 1982. At the 1981 Study Weekend the entomologist Sharon Collman gave an entertaining, clever and useful talk on garden insect pests. This lightened the atmosphere so much that the Committee organizing the Portland meeting decided to try again. It was recognized by all concerned that this paper was to serve as a comic interlude, without lots of graphs, charts and scientific names. Its publication in present form is due merely to the general interest in a real problem, and the rather dim light thrown on the problem by the speaker.

Nature of the Problem

It will come as no surprise to students of plants that the processes of natural selection have been working on the animal kingdom as well as on the plant kingdom. Present species of animals are likely to owe their success to several advantageous characteristics. What can we say about slugs? Molluscs had good shells early in the Cambrian period 600 million

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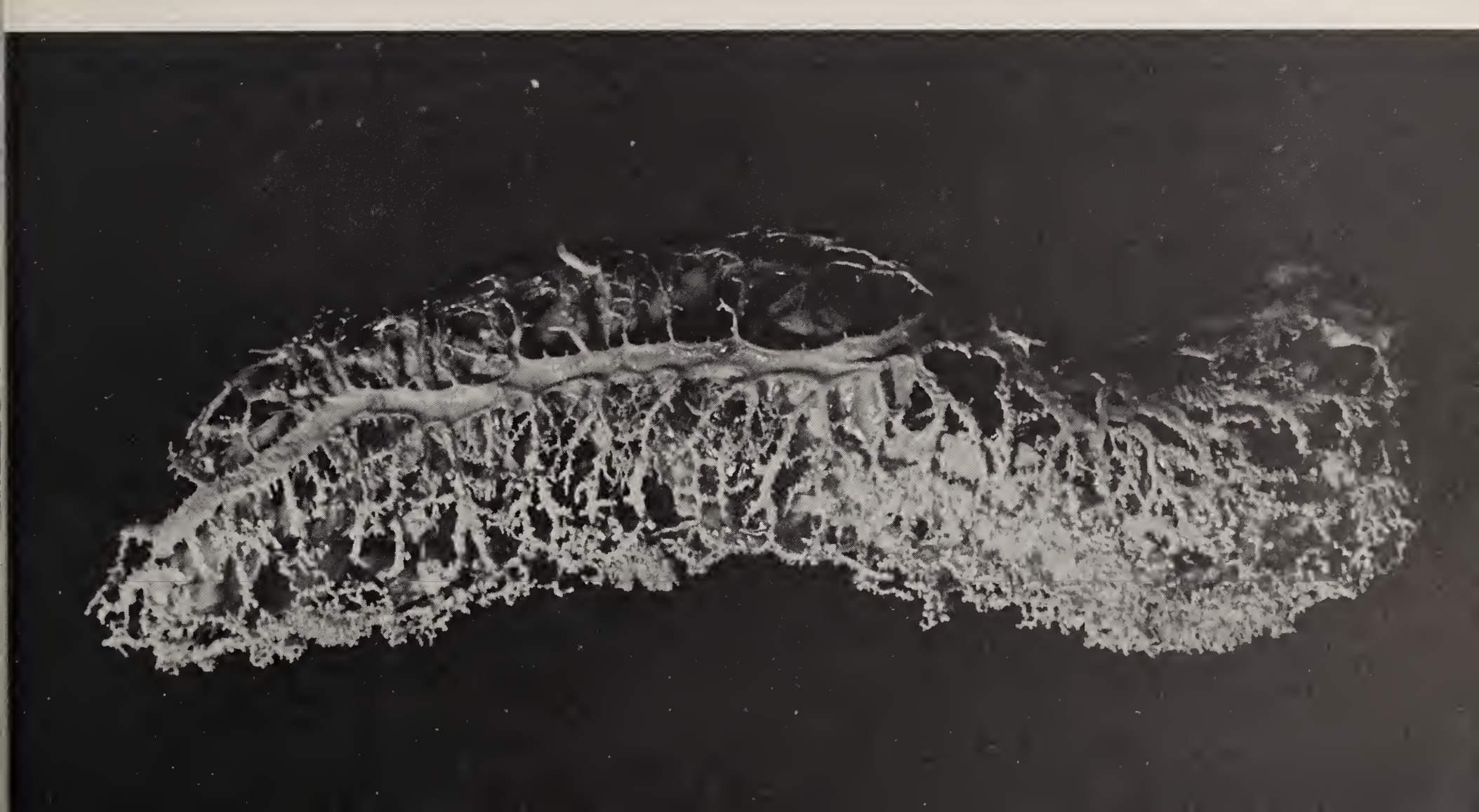
years ago, and most of them have retained this marvelous defensive device. A few others, like squids and octopuses, have dispensed with mechanical protection and depend on speed and brains to escape the confinement represented by a shell. Slugs have little speed and very simple brains, and yet have also managed to escape the shell. Perhaps the "lowly" slug is not a plague visited on man to remind him of his iniquities in the garden, but a selected opponent demanding respect. We shall have time to examine only a few of the adaptations that have made this possible.

Resistance to desiccation. Slugs are confined to areas of fair moisture content with adequate shelter. Even so they must be able to withstand desiccation, and indeed can perform reasonably well after being dried to 50% of their normal body weight. Given the opportunity they maintain a reserve of fluid stored mostly in the crop and large intestine, upon which they can quickly draw. There is an old and large literature on adaptation to desiccation, so I would prefer to talk briefly upon a more recently discovered adaptation, an observation made right here in Seattle.

Resistance to water overload, and its use in some emergencies. A simple experiment you can do in your garden with any large slug will illustrate dramatically one of its adaptations. Pick up the slug (wearing rubber gloves if you are squeamish), place it on a small board and watch it for a few minutes to locate the pneumostome. A group of gastropod molluscs, called Pulmonates, have given up the use of gills and have developed a simple lung. Air enters and leaves the lungs through the pneumostome, which can be found on the right side of the body in about the first third of the body length, and the slug normally opens and closes it frequently. While the pneumostome is open quickly insert the tips of a pair of tweezers into it, and give the lips of the pneumostome a good stretch. Your subject will be reluctant to cooperate, so halfway measures will not do. If you are successful, suddenly large drops of fluid will begin to emerge from the pneumostome. The fluid is colored a light blue, due to the copper-containing pigment hemocyanin dissolved in it, and the flow continues for several seconds. You may think you have punctured the lung tissues of the slug so that blood is leaking out—not at all, for in this few seconds the slug itself vents all of the blood in its body. How can we feel sure that such is the case? Injections of specific, harmless chemicals near the nervous center (ganglia) of the slug will produce the same response, and the experiment can be done repeatedly if the slug body is filled up immediately with a salt solution that is close to the salt composition of

What a slug might look like from inside. The animal was injected with liquid vinyl, the injection mass allowed to harden, and all of the slug tissues dissolved away. The large vessels are veins which return the blood to the heart, the solid masses show where the blood space (hemocoel) occurs. The space occupied by the viscera, muscles and skin is, of course, open.
Photo: A. Martin



slug blood. We think that, in nature, a slug vents its blood to repel beetles or other predators, or to lower its freezing point on a sharp cold night, or to escape entrapment, or to compensate for falling into a body of water and taking on too much water before it can crawl out. You may ask, as others have done, why a slug should commit suicide to escape whatever difficulty it has gotten into. The slug is not suicidal at all! If you put it away in a sheltered place it will draw on its fluid-reserves to restore its blood volume, and in a few hours will begin crawling around and then begin feeding. This is a striking adaption indeed, for the blood volume of a slug is about 30% of its body weight and the loss completely immobilizes the slug for an hour or two.

Nervous system. We have belittled the slug with respect to thought processes; slugs can solve simple problems! In an amusing story an orchid grower reported that his orchids were left alone unless they were in bloom, in which case slugs ate the flowers. One year some unusually choice orchids were expected to bloom and special precautions were taken to prevent slugs from reaching the plants. One night the orchids bloomed; in the morning many of the flowers had been eaten. The slugs had let themselves down from the rafters on threads of mucus until they reached the plants.

A student of mine once isolated slugs in a bathtub, placing them on a rock island surrounded by water. Perhaps a slug has no concept of "island"; nevertheless, after an interval the slugs crept into the water and crawled underwater to the side of the tub. This is a real feat for a slug because water weakens the mucous trail on which it moves. After a few inches of travel the tail begins to lose its grip and when the entire foot loses its grip the slug will drown.

Slugs will enter water for another reason besides escape. The student cut an automobile tire in half circumferentially and buried one half in soil inside a large box so that the edges of the tire were flush with the soil. He placed water in the tire, food in the center of the soil enclosed by the tire, and slugs in the box outside the tire. The hungry slugs crawled under the water to the food, and some even returned through the water after feeding, preferring to spend non-feeding time in the relative darkness on the wall of the box. At this point one may well ask why does a slug drown in beer? Let us defer the answer for a short time.

Slugs can creep through very narrow channels. Pieces of glass tubing, representing the only means of escape from a bottle, can be used to test a slug to the maximum. Measurement shows that in one species of slug its resting body length is usually seven times as long as its diameter. In order to escape, the slug will enter the narrow glass tubing and stretch out along its length. Usually it emerges safely even though it cannot breathe during the process. In this case the length of the slug can stretch to twenty times its diameter. This tells us that in nature slugs can find safety in shelters which open to the outside world through very small entrances.

Reproduction. We need say very little about how prolific slugs can be. They are hermaphrodites, although in some species the animal is first male, and only a few weeks later is female. They grow rapidly so that more than one generation a year is common, the last eggs laid in the fall overwintering until the next spring. But our large banana slug (*Ariolimax columbianus*) lives more than one year, and may have more than one reproductive period. The slug is sensitive to moisture and will not lay eggs when the water saturation of the soil is below 10%. Eggs do best at 75% soil water, and apparently will not hatch at either 25% or 100% water saturation. Quite susceptible to temperature extremes when first laid, the eggs soon become relatively hardy, and may hatch after only 11 days, the length of time before hatching being dependent upon temperature.

The Number of Slugs

An enthusiastic gardener may go out early in the spring and kill fifty or more slugs in the garden, feeling with satisfaction that much of the problem is solved. But the next morning there may be another fifty, and so on. Just how large a population is the gardener attacking? If we assume that an area is closed off, we can examine the results of some ecological studies where serious efforts have been made to assess the population size. In a sizable market

garden enclosed by a wall, about 100 slugs each of three different species were collected, marked by the injection of some dye, and released again. After a couple of days careful collections were made again, and of each species collected the previously marked animals were identified. On the whole the marked animals made up only about 5% of the collection. So the 300 animals first collected and released were a sample of a total population of about 6,000. This seemed so large a number that the investigator wondered if it could be true! He chose sample plots, excavated the ground to a depth of two feet, and painstakingly counted all the slugs in each sample plot. This number, corrected for the total area of the garden, checked quite satisfactorily with the easier estimate made by releasing marked slugs. These numbers are probably representative of our local conditions: for every slug you kill there are about 20 others in reserve, so to speak. Our enthusiastic gardener will have to kill fifty slugs every day for twenty days, while still more eggs hatch and slugs move in from surrounding yards, or from woods and parks.

Control of Slugs

One can protect the most desirable plants through their period of greatest susceptibility. If a planting of peas is lost to slugs, the peas can be replanted and a greater effort can be made to protect them through the vulnerable period. Picking up and destroying slugs will obviously help, but this is not enough, and if the plants and slugs cannot coexist, some other method of slug destruction must be used.

Bait. About 1940, metaldehyde was discovered to have slug-killing properties and it was quickly introduced commercially. Tests of its use as a spray showed that this is not an effective method except, perhaps, in greenhouses. It was found that the poison would be ingested if mixed with a material attractive to slugs, like the bran of various grains. Pelleted baits of different sizes, concentrations and attractants are now available. But the results are less than perfect. Trials by Hunter and Symonds (Runham and Hunter, 1970) show that 6% metaldehyde pellets gave significantly better control than 5%, 4% or 3% metaldehyde. If the metaldehyde concentrations was below 5% most of the slugs recovered, especially when the weather on the following day was warm and moist. However, the higher concentrations, more dangerous to birds and to pets, sometimes merely sickened the slug, who would stop feeding and so escape. Nevertheless, when you read the label on the box of slug bait you next buy you may well be disappointed at the level offered to you. You may have to do some shopping around, and pay more, for a bait with a higher concentration of metaldehyde than 2%.

A group of insecticides, the carbamates (carbaryl, etc.) was discovered to be active against slugs about 1959. Unfortunately the range of toxicity is wide, some carbamates being more than five times as toxic as metaldehyde, while others are much less toxic than metaldehyde. Laboratory methods of evaluation of baits have not been highly developed, but the killing effectiveness of a poison appears to depend not only on the toxicity but the attractiveness of the bait, and so on the amount eaten by the slug. It has been recommended that baiting be kept up to be effective, in the autumn before the last egg laying, as well as in the spring when the gardener's attention is strongly directed to the depredations of slugs.

The placing of containers of beer in the garden has been reported to drown slugs. Since we have already seen that slugs can crawl through water this may appear to be a contradiction. Investigation shows that molluscs are easily anesthetized by ethyl alcohol, and the 3 to 5% concentration of alcohol in beer is adequate for producing anesthesia. The slug becomes unable to creep out of the beer and so drowns itself. It would be rather amusing to conduct a test of different beers. We have noted that the bran of grains is attractive to slugs and, no doubt, the grain extracts present in beers would also prove attractive. The question, then, would be whether the more malty ales would be more attractive than an ordinary beer; and one might ask if the hops in a beer are an added attractant.

Predators. The use of predators against slugs has not been successful so far. Garter

snakes eat slugs, but not voraciously enough to keep them at a low level; nevertheless snakes should be encouraged around a garden. Beetles, of only a few species, will attack slugs, but this is uncommon. Ducks are too much trouble to keep in the average home garden. How about carnivorous slugs? There is an excellent species, but it does not do well in this area. It might be worth someone's time to learn to raise quantities of these carnivorous slugs and sell them for release as early in the spring as they could be found to persist. It would not matter if they wintered over in nature if a fresh supply could be raised economically over the winter.

Popularizing slugs as a delicacy. Wouldn't it make for effective control if slugs were considered a delicacy and were gathered avidly as a gourmet treat? Snails have attained this status in France, and must be raised commercially to supply the market. Snails are now being marketed in California, and collectors are paid for bringing them in.

How about slugs? Since slugs occur in France it would appear likely that they have been tried, and their absence from the cuisine promises poorly. Slugs have one potential advantage over snails from this point of view. The viscera of the snail are consumed along with the muscles, and snails are ordinarily fed bran for a week to clear out the digestive tract. There is so little meat left that it hardly pays to dress a snail. A slug, on the other hand, has a meaty body and is easy to dress. The large intestine and the kidney both empty through the pneumostome. If one cuts the body wall clear around the body just behind the raised mantle and pulls the two ends apart, all of the viscera will come out attached to the head and can be thrown away. The posterior end, entirely muscle and skin, can then be immersed in a dish of vinegar to stop mucus secretion and the entire bowl of prepared slugs can be washed to be ready for cooking.

It appears more likely that gardeners might try this method of control than gourmets. There is a mystique about snail eating, actually a ritual, in which cooked snails are inserted into selected shells, then extracted again by the eater. Perhaps slug eating would profit from its own ritual? Northwest gardeners are encouraged to try various preparations and rituals. Note that the slug body lends itself to being stuffed! A tasty garlic and bread stuffing might be exactly right. A baby carrot, or a slice of zucchini might prove to be the perfect match. When you have discovered an appealing formula, write it up and we will report it here . . .

Conclusion

The author was asked at the Winter Study Weekend if he had tried eating slugs. In the garden he is just another peasant, perforce sharing his flowers and vegetables with the ever-present slugs, and fighting them with variable success. But, he argues, he has a better reason for not being the leader in the gourmet campaign than other gardeners. The reason is that in the laboratory he may spend an entire day studying the physiology of one or more slugs, and may do this several times a week. To him the slug is an exciting, even a beautiful animal. It still presents problems of physiology that will take years to work out. So when he comes home he is willing to eat oysters, or clams or scallops, or abalone, but so far has resisted testing slugs.

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This shaded bank in a Seattle garden provides an appropriate habitat for mosses. Here, they serve to retain moisture for delicate herbs and shrubs. Photo: J. Bolivar

More Than Just Lawn Weeds— Mosses in Your Garden

*BONNIE M. TUCKER**

To us as westerners, a lush green lawn is a symbol of a healthy beautiful garden. When mosses invade these grassy expanses, we often make moves to kill them. However, lawn is to a European or American garden what moss is to a Japanese garden. The Japanese have discovered that mosses provide an ever-changing variety of textures and colors—changes with the seasons as well as with the small daily fluctuations in the weather. Thus, they claim that you cannot tire of a view of a moss garden no matter what the length of time you may watch it.

A silky moss among *Soldanella* lends beauty to the above-mentioned mossy bank. Photo: J. Bolivar

*Bonnie Tucker, Associate Curator of the University of Washington Herbarium, became interested in mosses when she moved to the Pacific Northwest. She studied with Dr. Elva Lawton, and has conducted workshops on mosses for amateurs.

The success of moss gardening in Japan is due in part to the particularly frequent rainfalls experienced there. Western Washington with a similar climate also provides an ideal setting for the propagation of mosses. However, before you tear up your lawn in your newly acquired excitement for mosses, you should be aware of some cultivation techniques which may spare you some initial failures. The most obvious and critical step is to pay close attention to the habitat and microhabitat in which the moss you select is growing in the wild. Your success will depend upon your ability to duplicate these conditions in your garden. In general, mosses require moist, acidic soils and shaded sites which protect them from transpiring excessively. Take care to prevent the soil from becoming water-logged because this condition can be the worst enemy of all but bog-inhabiting mosses. Because many mosses are restricted to specific substrates, be sure to bring the moss with its substrate into your garden. If it is growing on rock, bring the rock, if on wood, it will need wood of a similar type and state of decay. You should also provide additional comparable substrates to enable the moss to grow and spread.

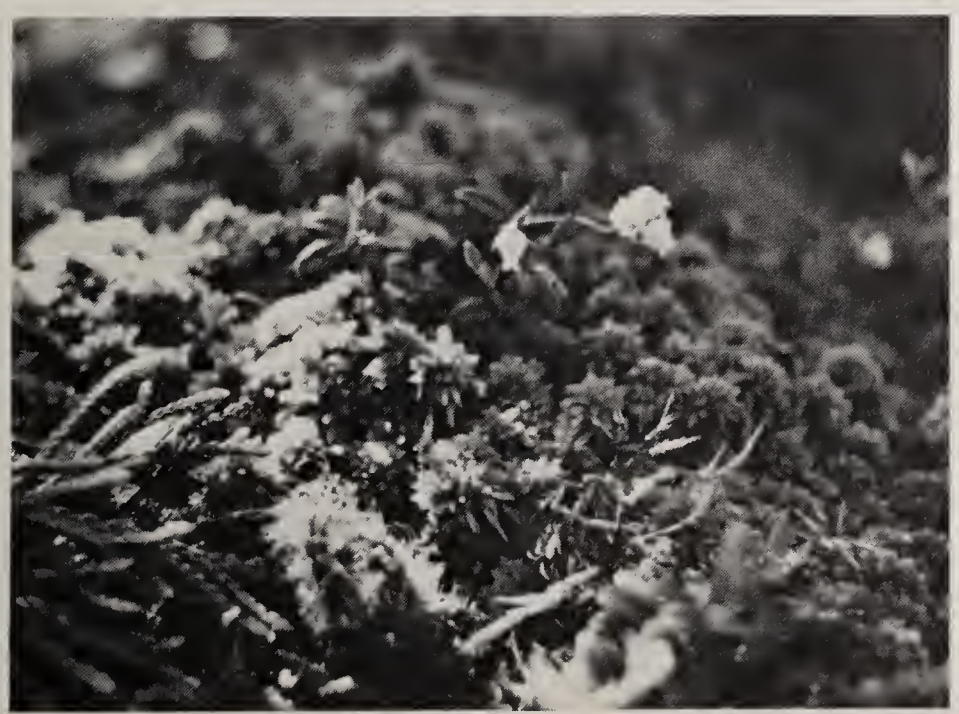
Michael F.V. Fletcher (1981) claims that many species of peat moss (*Sphagnum*) grow reliably and may develop attractive colors. Their basic requirements are acidic, water-logged soils. He grows 40 different species in plastic flower pots on commercial *Sphagnum* peat, standing in plastic seed trays with no drainage holes. Pruning is a simple process if the stems become too long: remove the whole plant, cut off the appropriate amount from the bottom and replace it in the pot.

Mrs. Florence Free, a successful Seattle moss gardener, keeps mosses out of her lawn but places them underneath herbs and shrubs scattered throughout her yard. Mosses prevent the soil from drying out, and some shrubs such as *Cassiope stelleriana* seem to require this protection. She allows some delicate-textured mosses (e.g. *Eurhynchium praelongum* var. *stokesii)* to blanket the ground between stepping-stones. Mrs. Free also finds that a thick layer of mosses can be an effective protection against erosion, but you may wish to keep them out of rock gardens. Mosses can be invasive and may overrun low, slow-growing alpine plants.

If you are interested in covering an extensive area with mosses, you will want to use mosses which are commonly prostrate (pleurocarpous) or creeping and which usually form mats. Appropriate species common in western Washington are *Eurhynchium praelongum* var. *stokesii, Hylocomium splendens,* and *Calliergonella cuspidata.* Tufted mosses (acrocarpous) make attractive cushion plants which provide nice accents in a moss garden. Many species of *Dicranum* and *Bryum* are tufted mosses which are easy to grow. A less common but very beautiful tufted moss is *Bartramia pomiformis.*

A moss garden can provide an exciting new dimension to your garden. But be aware that an extensive moss garden can require a great deal of maintenance. Start on a small scale in a little shaded spot in your garden and let your success with these delicate and fascinating plants entice you to expand.

Peat moss, *Sphagnum*, for that especially wet spot in the garden. Photo: J. Bolivar



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The hair-cap moss (*Polytrichum*) in a Seattle garden. Photo: J. Bolivar

The Cryptogamic Carpet— Mosses in Seattle

*ARTHUR LEE JACOBSON**

Editor's Note: The cryptogamic *plants, those whose reproductive structures are relatively inconspicuous, include mosses, ferns, and their allies. In contrast,* phanerogamic *plants have readily distinguishable structures such as cones or flowers to facilitate their reproduction. The moist climate of Seattle is ideal for the growth of mosses—they spring up or creep along, covering, softening outlines, and brightening our misty gray with green.*

Moss Ecology

Though humble in size, mosses play significant roles in nature. Chiefly, they are plants which thrive in those habitats where more complex, larger plants are unable to grow, such as on our roofs and in the cracks of our streets. Clearly, mosses are tough and adaptable. Notice how they can shrivel up during dry spells in order to conserve their vital water, and then become lush again after being refreshed by rainfall. Notice how well they spread and multiply. Their countless tiny reproductive cells are borne by the wind like pollen to every imaginable place. We see mosses covering the forest floor, growing on exposed, disturbed soils, spreading over tree trunks, logs, walls and rocks. But ironically, certain mosses find themselves in the position of those people who, after politely holding open a door to admit others, find it closed to themselves. As an example of this phenomenon of plant succession, imagine the following: a gigantic pile of heavy clay soil is

*A. Jacobson, a student in history at the University of Washington, studied mosses there with Dr. Elva Lawton. He has been compiling the list of mosses in Seattle since winter, 1981.

excavated from a construction site, trucked to a meadow and dumped in a big pile. By the following spring it is covered with a thick, colorful carpet of cord moss *(Funaria hygrometrica),* a pioneer species. But, inevitably, grasses and other plants will invade the pile and eventually drive out the moss. In time trees will grow up and will shade out the other plants. At this point other sorts of mosses will return, to grow on the trees and on the shaded ground.

Within and underneath these green, living carpets, many plants, micro-organisms and small insects live. The licorice fern often grows with moss. Bushtits and other birds are kept happy building nests with mosses. Indeed, the only enemies of mosses are certain folks who cannot tolerate mosses on their roofs, or in their lawns and gardens. In this case, the meek do inherit the earth.

Seattle's Mosses

Seattle has an interesting, very rich moss population. How many different species grow within the 100 square miles of the city? We are unsure, but around 100 is a good estimate. (The city of Vancouver, with a climate similar to Seattle's, has more than 130 species of moss, so more may eventually be found in Seattle.) As with the trees and shrubs in Seattle, a certain few species of mosses are dominant and extremely abundant; a much larger number are rare and often restricted to special micro-habitats. For example the peat moss *(Sphagnum squarrosum)* appears to grow only in one place in Seattle: the cattail marshes of Union Bay. In general, Seattle has almost all of the very common mosses which occur in lowland western Washington.

The University of Washington has a still-expanding moss herbarium boasting more than 70,000 specimens. Many species which were collected in Seattle's parks from the 1890's to the 1940's seem to be either very rare or extinct now. In fact, Seattle's mosses simply have not yet been thoroughly studied (nor has its flowering-plant population been adequately documented). We who investigate the matter continue to discover new and noteworthy finds, including rare mosses. One moss recently collected from the mud at the Montlake Playfield, not far from the Arboretum, proved to be *Amblystegium saxatile* which had apparently been collected only once before in this state—in the 1890's near Mt. Rainier!

Because of its unusually wide diversity of habitats suitable for mosses, the Arboretum probably has more different kinds of mosses than any other place in the city; perhaps 70 can be found growing there. A significant few have been found *only* at the Arboretum, including *Eurhynchium serrulatum,* which must have been introduced with some planting-stock, as it had not heretofore been known west of the Mississippi River! Mosses even grow on our freeway now.

Moss Study and Identification

Dr. Elva Lawton has been at the University of Washington for over 20 years. She is curator of the moss herbarium, has taught many students about mosses, and is the author of *The Moss Flora of the Pacific Northwest.* Yet there are mosses that she cannot positively identify without microscopic analysis. This is because some mosses are so utterly small and so similar to related species that even the experienced eye cannot always distinguish them without magnification. But a number of common mosses are quite as distinct and easy to recognize as are eagles and chickadees. Features used for field identification of mosses include their general appearance, size, color and habitat. With experience, the knowledge of which species are common in an area—and which rare—is also of aid. It is important to remember that at different times of the year mosses exhibit seasonal changes, and take on a different appearance depending upon how moist or dry they are.

Some Common Mosses

People interested in being able to name some mosses will find the following selection a good set with which to start. We illustrate and describe mosses which are very common to ubiquitous in their particular habitats, and are sufficiently distinctive to be readily recognized.

On exposed soil with fluctuating moisture, such as is found in rockeries, expect to see the big juniper haircap moss *(Polytrichum juniperinum).* Notice that it grows in large mats or clumps and bears a remarkable similarity to

(1) *Sphagnum squarrosum*, x1.5. (2) *Aulacomnium androgynum*, x8: a. plant with gemmae; b. plant with capsule. (3) *Orthotrichum lyellii*, x16. (4) *Leucolepis menziesii*, x1. (5) *Hylocomium splendens*, x1. (6) *Grimmia pulvinata*: a. plant with capsule, x6; b. habit of plant, x1. (7) *Rhytidiadelphus squarrosus*, x2.5. (8) *Tortula muralis*: a. plants, x1; b. plant with capsule, x8; c. tip of capsule, seen with magnifying glass, x38. (9) *Polytrichum juniperinum*: a. plant, x1.5; b. capsule,

x5. (10) *Eurhynchium praelongum* var. *stokesii*, x2. Figures 1, 6a-b, 7, 8a-b and 9b from W.B. Schofield, 1969, *Some Common Mosses of British Columbia*, courtesy of the British Columbia Provincial Museum; figure 9a from J.J. Dillenius, 1768, *Historia Muscorum*, J. Millan, London; all other figures from E. Lawton, 1971, *Moss Flora of the Pacific Northwest*, by permission of the publisher Dr. Sinske Hattori.

the juvenile foliage of junipers or the "Moss" cypress *(Chamaecyparis pisifera* 'Squarrosa'). During dry weather the leaves of the juniper haircap tightly hug the stem, like a closed umbrella; in moister conditions they stick out like bristles. The color is dull green mixed with rich brownish red hues. The 'haircaps' (called calyptras), the covering over the erect spore-producing structure, are pale yellow and silky, and very showy when present. The juniper haircap is one of the larger and more conspicuous mosses in Seattle, and has only one look-alike to confuse you: *Polytrichum piliferum.*

Another common moss of well-drained, exposed soil is the purple horntooth *(Ceratodon purpureus).* It is tiny, grows in small clumps and is distinctly purple during much of the year.

In lawns the most common, abundant and luxuriant moss is the redstem bentleaf moss *(Rhytidiadelphus squarrosus).* It grows extremely thickly and gives a decidedly greenish-yellow color to lawns. This species and the other three common lawn mosses in Seattle are more readily found in lawns than in the wild. If the moss in your lawn has reddish stems and the leaves are obviously bent downwards at sharp angles, it is *Rhytidiadelphus squarrosus.* Otherwise it is probably one of the following: *Brachythecium albicans, Calliergonella cuspidata,* or *Pseudoscleropodium purum* (an introduction from Europe). Applications of lime and iron-rich fertilizers tend to discourage lawn mosses.

On cement walls many mosses grow, most of which are difficult to identify. The silver cushion moss is an exception. In several common mosses which grow on concrete we see a silver-greyish color present because the tips of the moss leaves are long, colorless awns which reflect the light. The silver cushion moss *(Grimmia pulvinata)* is a common and obvious example. Wall moss *(Tortula muralis)* is also extremely common on cement, but is greener and a bit larger. It is safe to say that an old cement wall with mosses will surely have both of these species, as well as several others.

A dendroid (treelike) moss of our woods, which resembles a miniature palm, is called Menzies' tree moss *(Leucolepis menziesii).* It grows on moist maple trunks or on rotten logs, and in the humus-rich soil of our forests. It is not always easy to find, but is unmistakable. It can only be confused with the very, very rare (in the city) big tree moss *(Climacium dendroides).* In Seattle, *Climacium* is found only in the muck of Foster's Island, and even there is not as abundant as Menzies' tree moss.

In moist shady woods, on rotten stumps and logs, lovers' moss *(Aulacomnium androgynum)* grows. It is rendered very distinctive by its non-sexual reproductive equipment. Like other mosses, it can send up spore-filled capsules. . . but in addition it produces asexual 'gemmae' in great abundance. These little round balls are borne on tiny pegs above the uppermost leaves of the individual moss shoots. If you look for lovers' moss, you will find it, for although tiny, it is abundant. Many other mosses also grow on decaying wood in the forest. The very, very pale white-green one that forms large flat mats is *Plagiothecium undulatum.*

Slender beaked moss *(Eurhynchium praelongum stokesii)* is surely to be found in the woods. It is regularly encountered on mossy trunks of maple, in clumps of lady fern, on rotten logs or clay soil, or hanging in strands from shrubs in very moist ravines. It cannot be readily distinguished by the beginner because so many look-alikes occur, but it is so common that it will certainly be seen.

Orthotrichum lyellii is the most common of five species of *Orthotrichum* in Seattle. It is also the largest. These mosses are usually found high up in willows, alders, madronas and maple trees. When you find a fallen limb from such a tree, you will probably find this moss if any at all are present—the habitat is too dry for other species. Lichens can tolerate the conditions where we find *Orthotrichum,* as can one other common moss, *Dicranoweisia cirrata.*

Mountain fern moss *(Hylocomium splendens)* is a moss to look for. It is very large and conspicuous and resembles miniature fronds of ferns. It is common in forests of the Puget Sound lowlands, except in Seattle. Although it has been found here in the past, it is now either very rare or extinct. If anyone locates *Hylocomium* in the woods of Seattle, we would be glad to know about it!

The Mosses Speak. . .

In the old-fashioned language of flowers, the birch tree signified gracefulness, the cabbage profit, the fern simplicity, the lichen solitude, the mushroom suspicion, the nettle cruelty, the rose beauty and the thistle austerity. A tuft of moss stood for maternal love. We appreciate the beauty that these humble plants lend to barren rock, tree trunk and soil, with their comforting carpet of green.

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A LIST OF THE MOSSES FOUND IN SEATTLE

Some of the following are common, others rare, and a few have not been collected since the 1930's. Doubtless a few other rare mosses occur in the city, but have not found their way onto this list.

SPHAGNACEAE
Sphagnum squarrosum

TETRAPHIDACEAE
Tetraphis pellucida

BUXBAUMIACEAE
Buxbaumia piperi

POLYTRICHACEAE
Atrichum selwynii
Atrichum undulatum v. *gracilisetum*
Polytrichum juniperinum
Polytrichum piliferum

FISSIDENTACEAE
Fissidens bryoides

DITRICHACEAE
Ceratadon purpureus

DICRANACEAE
Dicranella heteromalla
Dicranella schreberiana
Dicranella subulata
Dicranoweisia cirrata
Dicranum howellii
Dicranum fuscescens
Dicranum tauricum

POTTIACEAE
Barbula convoluta
Barbula vinealis v. *flaccida*
Barbula vinealis v. *vinealis*
Didymodon tophaceus
Pottia truncata
Timmiella crassinervis
Tortula amplexa
Tortula bolanderi
Tortula latifolia
Tortula muralis
Tortula princeps

GRIMMIACEAE
Grimmia apocarpa v. *gracilis (stricta)*
Grimmia pulvinata
Grimmia trichophylla
Rhacomitrium canescens v. *ericoides*
Rhacomitrium heterostichum v. *heterostichum*
Rhacomitrium heterostichum v. *occidentale*

GRIMMIACEAE continued
Rhacomitrium varium

FUNARIACEAE
Funaria hygrometrica
Physocomitrium megalocarpum

BRYACEAE
Epipterygium tozeri
Leptobryum pyriforme
Bryum argenteum
Bryum bicolor
Bryum capillare
Bryum lisae v. *cuspidatum (creberrimum)*
Bryum pseudotriquetrum v. *bimum*
Pohlia annotina
Pohlia longibracteata
Pohlia nutans
Pohlia wahlenbergii

MINIACEAE
Leucolepis menziesii
Plagiomnium insigne
Plagiomnium venustum
Rhizomnium glabrescens

AULACOMNIACEAE
Aulacomnium androgynum
Aulacomnium palustre

ORTHOTRICHACEAE
Orthotrichum consimile
Orthotrichum lyellii
Orthotrichum pulchellum
Orthotrichum rivulare
Orthotrichum striatum
Ulota crispa v. *alaskana*
Zygodon vulgaris

NECKERACEAE
Neckera douglasii
Neckera menziesii

LESKEACEAE
Pseudoleskeella tectorum

CLIMACIACEAE
Climacium dendroides

THUIDIACEAE
Claopodium bolanderi
Claopodium crispifolium

THUIDIACEAE continued
Heterocladium macounii

AMBLYSTEGIACEAE
Amblystegium juratzkanum
Amblystegium saxatile
Amblystegium serpens
Amblystegium trichopodium v. *trichopodium*
Calliergon cordifolium
Calliergonella cuspidata
Drepanocladus aduncus
Drepanocladus uncinatus
Hygrohypnum ochraceum
Pleurozium schreberi

BRACHYTHECIACEAE
Brachythecium albicans
Brachythecium asperrimum
Brachythecium plumosum
Brachythecium starkei v. *explanatum*
Eurhynchium oreganum
Eurhynchium praelongum v. *stokesii*
Eurhynchium serrulatum
Homalothecium fulgescens
Homalothecium nuttallii
Isothecium cristatum
Isothecium stoloniferum
Pseudoscleropodium purum
Scleropodium cespitans v. *cespitans*
Scleropodium obtusifolium
Scleropodium tourettii v. *colpophyllum*
Scleropodium tourettii v. *tourettii*

PLAGIOTHECIACEAE
Isopterygium elegans
Plagiothecium denticulatum
Plagiothecium laetum
Plagiothecium undulatum

HYPNACEAE
Hypnum circinale
Hypnum subimponens

RHYTIDIACEAE
Rhytidiadelphus loreus
Rhytidiadelphus squarrosus
Rhytidiadelphus triquetrus

HYLOCOMIACEAE
Hylocomium splendens

The crisp foliage of *Alnus firma*, with nearly mature fruits (page 19). Photo: B.O. Mulligan

Alders in the Arboretum

Part II—Asiatic Species

BRIAN O. MULLIGAN

Editor's Note: This concludes the set of two articles written about the native and exotic alders of our Arboretum. The finale of horticultural recommendations should prove most useful to a gardener desiring a suitable and reliable alder.

Western Asiatic Alders

Only one species of alder from western Asia grows in the Arboretum, namely *Alnus subcordata,* native to the Caucasus region and to northern Iran. This species is closely related to the Italian alder, *A. cordata,* but has downy instead of smooth shoots. Also, the leaves of *A. subcordata* are more elongated and less rounded at the base than those of the Italian alder, and the leaf margins are often doubly instead of singly toothed. Seeds of *A. subcordata* were received from the Ariamehr Botanic Garden, Teheran, in March 1976. They had been collected at Mahmudabad on the southern shore of the Caspian Sea. Three four-foot plants were set out in the Arboretum just last year, in January 1981. They can be found inside the entrance to Foster's Island, close to the water channel. All appear to have grown satisfactorily in their first season. It will be interesting to watch their progress here, especially in comparison to the known capabilities of the large and fast-growing *A. cordata. Alnus subcordata* may well become an equally large tree.

Japanese Alders

It is to Professor Saburo Murai that we are indebted for our plants of *Alnus fauriei, A. inokumae, A. pendula* and *A. sieboldiana.* He is the author of several authoritative studies, both on Japanese and on world-wide alders, and in 1964 separated the Japanese species into two subgenera, namely *Alnaster* and *Gymnothyrsus.* In the subgenus *Alnaster,* the winter buds are sessile, the male inflorescences appear but do not open in the fall, and the female inflorescences appear the following spring

when both flower. Furthermore, the leaves have more than ten pairs of veins, and the seeds possess arrow-shaped wings larger than the nutlets. In *Gymnothyrsus* on the other hand, the winter buds are distinctly stalked and both types of flowers form in the fall but do not open until spring. The veins of the leaves number fewer than ten pairs, and the seed wings are orbicular in shape and smaller than the nutlets. We shall follow Professor Murai's arrangement here and will deal first with the three species in the subgenus *Alnaster.*

Subgenus ALNASTER

Alnus sieboldiana and the closely related *A. pendula* and *A. firma* all grow into large shrubs or small trees. Their leaves are multiveined, ovate-lanceolate in shape, and acute at the tip.

Alnus sieboldiana is native only in eastern Honshu, the main island of Japan, especially near the sea. In midwinter, the clusters of short green unripe male catkins are very evident near the ends of the branches. The female cones are dry, oval, 1.5 to 2 cm long, borne singly on a pedicel about 1 cm long, the small bracts reflexing. The young shoots are light brown and glabrous; the sharply pointed green buds are also smooth. The leaves are ovate to ovate-lanceolate, acuminate at the tip, 7.5 to 11 cm long, 4 to 5.5 cm wide. On the underside the leaves are silky pubescent along the veins, of which there are 9 to 11 closely set pairs. There are tufts of rust colored hairs in the vein axils, the leaf margins are conspicuously serrate, and the petioles stout and glabrous.

We have not as yet had much success in establishing this rather attractive species here. There have been three introductions of *Alnus sieboldiana* to the Arboretum, all propagated from Japanese seeds. The first lot received in 1956 from the Forestry Experiment Station of Kyoto University was planted in 1960, but none remained by 1970. The second set, from Professor Murai in 1963, was planted in 1969 and again in 1974; the former planting survived until the severe windstorm of November 14, 1981, when it was uprooted; it had been slightly damaged by cold in the winter of 1971. The second planting lasted only three years. The reason for its demise is not recorded. The third lot, raised from Professor Murai's seeds of 1967, consisted of three plants set out in the main collection in February 1979 when 10 feet in height. Only one now remains, 11 feet tall; the fate of the other two is unrecorded.

Alnus firma is also found wild in the southern and eastern parts of Honshu, but extends much farther south than does *A. sieboldiana,* to the islands of Shikoku, Kyushu and Yakushima. The young shoots are pubescent at the top, olive-brown, with conspicuous, sharply pointed buds about one cm long. The leaves are thin but tough, 7 to 12 cm long, 4 to 5 cm wide, elliptic-lanceolate, acuminate at the tip, the margins serrate with the larger teeth mucronate. There are 13 to 15 pairs of closely spaced veins raised beneath and pubescent. The petioles are stout and pubescent on the upper side; the oval cones are 16 to 18 mm long.

From seeds sent by Dr. D. Numata of Kyoto University in 1950 three plants were placed on Foster's Island in November 1951. These trees failed to survive to 1970, and three other plants set out west of Azalea Way in April of 1953 also failed to become established. Our second supplier was the late Mr. K. Wada, of Numazu-shi, who sent us seeds in 1968. A tree of this origin is now flourishing near the creek just north of Lake Washington Boulevard at its junction with East Foster's Island Road. This tree, planted in December 1976 when 12 feet in height, is now 21 feet tall and produced cones in 1980. It appears to enjoy this open site facing south.

The third of the trio of species in subgenus *Alnaster, Alnus pendula,* is native throughout

Foliage of the Japanese *Alnus sieboldiana*.
Photo: B.O. Mulligan

most of the western half of the islands of Honshu and Hokkaido, but does not extend as far south as *A. firma.*

There have been three introductions of *Alnus pendula,* all from Japanese sources. The first introduction, in 1950, by means of seeds from Kyoto University, resulted in a single plant being placed in March 1954 on the west side of the original memorial planting to Mrs. Alexander McEwan, across Azalea Way from the pool at the foot of Rhododendron Glen. This plant is still there, but has only developed into a shrub some 7 to 8 feet tall and wide, having been much suppressed by the adjacent yews, forms of *Taxus baccata.* Two other plants from the same stock were set out in April 1955 farther west and near the small creek. They were killed by the November freeze of that year. The second introduction was in 1967 through Professor Murai, the seeds having been collected on Mt. Iwate in northern Honshu. Three plants from this seedlot were placed in the area north of East Foster's Island Road, in December 1974. They were 9 to 10 feet tall at that time; one was broken off at the base the next year, the remaining two are now small slender trees 11 and 12 feet in height. The site may be too shady for their liking, due to other native alders around them. Another *A. pendula* planted in the main collection in February 1979 near the creek is now 9 feet high and growing satisfactorily. The third introduction, consisting of a single plant received from the National Arboretum, Washington, DC, in 1971, was derived from seeds collected much to the south of the previous lot, in the Shiga Prefecture near Kyoto. This has now become a small tree 13 feet in height with an unfortunate kink in its trunk. We have suspicions that this tree may prove to be *A. firma,* since the leaves have only 9 to 12 pairs of veins instead of the 20 or more characteristic of *A. pendula.* There are also differences described in the female inflorescences of the two species which will have to be observed.

In the original introduction of *Alnus pendula,* the young shoots are thinly pilose, the buds are small, green and pointed. The leaves are lanceolate, acuminate at the tip, thin, the margins serrulate with the largest teeth mucronate. The upper surface of the leaves is pilose, the underside silky pubescent along the 20 to 28 pairs of veins. The petioles, 4 to 5 mm long, are slender and villous.

These three species of alder would all seem to have potential for more extensive use in parks and gardens in this region. The leaves resemble those of some species of hornbeams *(Carpinus)* much more than those of other kinds of alders.

Subgenus GYMNOTHYRSUS

Professor Murai has divided subgenus *Gymnothyrsus* into three sections: *Japonicae, Fauriae* and *Glutinosae;* we have representatives of all three in the Arboretum.

In section *Japonicae, Alnus japonica* itself was introduced (as *A. firma)* by seeds from the Royal Botanic Garden, Edinburgh, in 1945. Three trees were planted on Foster's Island in November 1947 and have flourished on this site close to the lake with a high water table. The largest is now 58 feet tall after exactly 34 years growth. This particular form has wider leaves than our other examples and may be the variety *arguta,* the more northerly variety of *A. japonica,* which grows wild from the northern half of Honshu up to northern Hokkaido and over to the mainland of Asia in Manchuria and northern Korea.

The second introduction of *Alnus japonica* was by seeds from Kyoto University (as *A. hirsuta)* in 1957. One tree from this source was planted in April 1961 in the main collection west of the creek, and by November 1981 it had attained 33 feet. The barrel-shaped cones, each about 2 cm long, were first seen in 1966.

Seeds ostensibly of *Alnus japonica* var. *arguta,* collected in southeastern Hokkaido, were sent to us by Professor Murai in January 1963. Three plants from these were set out in April 1968 when from 5 to 10 feet tall. They were placed on a slight mound in the main collection, but east of the creek. The largest is now up to 31 feet. The lanceolate, acuminate and serrulate leaves are similar in size (8 to 9 by 3 to 4 cm) to those of the type from Kyoto seeds. These plants may prove not to be the true var. *arguta,* for the leaves should be wider and more ovate in shape. The trees produced cones in 1972; these are ovate in shape, dark brown in color and about 2.5 cm long.

Alnus japonica also extends southwards to Taiwan where it has been called both *A.*

Alnus fauriei, a bushy alder with distinctive, pleasing foliage. Photo: B.O. Mulligan

formosana and *A. japonica* var. *formosana.* According to Dr. H-L. Li (1963) it is "very common throughout the island, from low altitudes up to 2,500 m., usually in river beds, stream banks, water edge, waste places or exposed areas." It was made a variety of *A. japonica* by Callier in 1911 but Dr. Li considers it "hardly distinguishable from those of other parts of eastern Asia," so we have followed his view here. Seeds were received from Taiwan in 1958 and a plant set out in Rhododendron Glen in March 1961 when 4½ feet tall. When young, this plant suffered some damage to the young soft shoots from several cold winters, but has now apparently outgrown this susceptibility and at 65 feet high is one of the largest non-native alders in the Arboretum. This indicates a growth rate of about 3 feet per year. The leaves are retained late into the fall or even early winter; it was still in full leaf in mid-November 1981. The ovate-lanceolate leaves have an undulate, irregularly serrulate margin, the apex acuminate and often twisted, the blades 10 to 13 by 5.5 to 7 cm, the veins usually 8 pairs rather wide apart and prominently raised beneath. *Alnus japonica* can be recommended as a distinctive, fast growing species evidently enjoying the same conditions as our native red alder.

A plant under the name of *Alnus lanata,* was raised from seeds received in March 1966 from the Hillier Nursery, Winchester, England. This appears to be either *A. japonica* or a hybrid derived from it. It was planted in January 1972 below the East Foster's Island Road when 12 feet tall and has now attained 26 feet. *Alnus lanata* is native only in western China; it was introduced by E.H. Wilson in 1908 to the Arnold Arboretum, but no doubt did not survive there for long.

A closely related species is *Alnus trabeculosa,* found both in Japan (central and southern Honshu and in Kyushu) and in southeastern China. *Alnus trabeculosa* and *A. lanata* differ from *A. japonica* in producing only a single large cone instead of several on each stalk. Seeds of *A. trabeculosa* collected in southeastern Honshu were received from Professor Murai in February 1967. Plants raised from these seeds were set out in January 1972 when 11 feet in height, near the creek flowing into the lake at Lake Washington Boulevard and East Foster's Island Road. Unfortunately, the vigorous native blackberries almost overcame the young trees and only two now remain, perhaps 20 feet tall and very slender. It is regrettable that others were not planted in a more open site where they could have had ample space and light to develop properly.

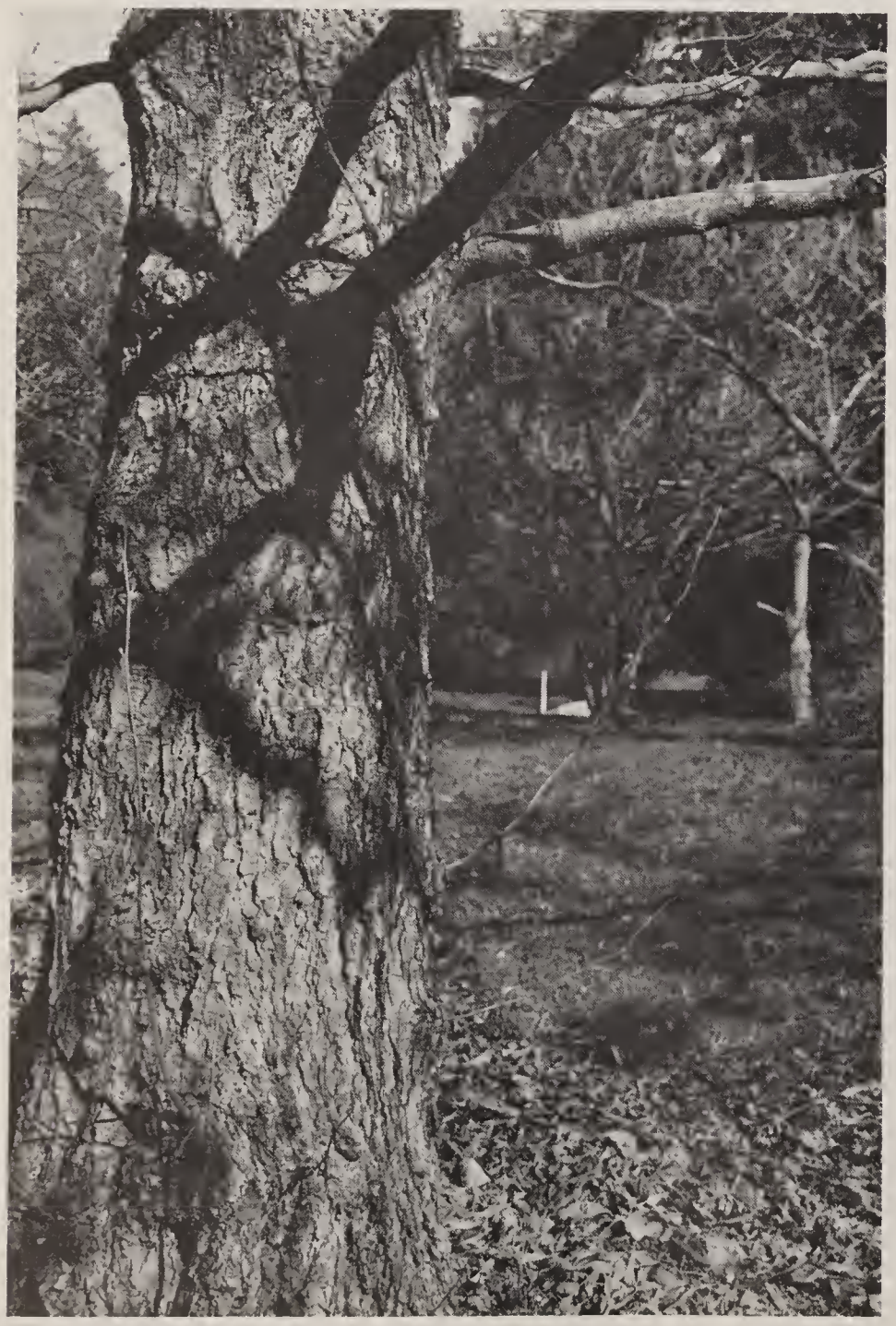
The small section *Fauriae* is represented here only by *A. fauriei,* a species endemic to the mountains of northern and central Honshu in Japan. It is well distinguished by its bushy habit and markedly obovate or retuse leaves wedge-shaped at the base, as well as by the tassels of narrow cylindrical gray male catkins

during the winter months and the clusters of conical female cones remaining on the plants well into winter. The leaves of *A. fauriei* measure 6 to 8 cm long, 5 to 7.5 cm wide. They are serrulate at the apex but become entire towards the base, with 5 to 7 pairs of rather widely spaced veins. The petioles are stout and glabrous.

Seeds sent by Professor Murai in 1963 had been collected at the most northerly station in Iwate Prefecture in northeastern Honshu. Two plants raised from these seeds were placed in a distinctly wet area in the main collection west of Azalea Way in March 1969 when seven feet tall. They have thrived in this situation and now measure 14 feet in height. Both have several stems from the base and are therefore large shrubs rather than trees; they first flowered in February 1971. A third plant placed beside the moon-viewing stand in the Japanese garden in 1971 is now only 9 feet tall; the trunk is cankered on one side, perhaps due to sun-scald or frost damage when young.

This is an interesting bushy species very distinct from all others in the collection.

The textured trunk of *Alnus hirsuta*, similar to that of *A. japonica*. Photo: B.O. Mulligan



In section *Glutinosae* there are two species, *A. hirsuta* and *A. inokumae*. *Alnus hirsuta* is distributed not only throughout all parts of Japan but is also found in northeastern Asia as far as eastern Siberia. Different varieties of *A. hirsuta* are found in Honshu and Hokkaido in Japan. The single tree of *A. hirsuta* in the Arboretum derives from seeds sent from the Botanic Garden of the University of Tokyo in 1951. This tree was planted out in April 1955 in the main collection west of Azalea Way and east of the creek, and is now 46 feet in height. The trunk is smooth, gray, 11 inches in diameter and tapers upwards quite rapidly, the branching more or less horizontal. The broadly ovate leaves are quite different from other species cultivated here, excepting the related *A. inokumae*. They are 7.5 to 9 cm long and nearly as wide, lobulate, serrate on the margins, truncate at the base. The upper surface of the leaves is completely pubescent, but below only the veins are hairy. Our specimen is probably *Alnus hirsuta* var. *tinctoria*. The clusters of male catkins, purple during the winter, open in mid- to late February and are quite showy and conspicuous. The female cones are ovate, 1.5 to 2 cm long, chocolate brown in color.

Another introduction of *A. hirsuta* was by means of plants sent from the USDA Plant Introduction Station, Glenn Dale, Maryland, in April 1965. These plants had been raised from seeds collected at the northern tip of Honshu. Two were planted out in March 1969 adjacent to the earlier tree of this species described above; they have grown satisfactorily, particularly the western tree, which is now 39 feet in height. This introduction probably represents the northern variety *A. hirsuta* var. *hirsuta*, because the leaves have a whitish pubescence beneath and the young shoots are villous. The trunks of these specimens are quite smooth and the branches tend to angle upwards. The leaves are similar in shape but perhaps slightly longer and narrower than those of *A. hirsuta* var. *tinctoria*, and are wedge-shaped at the base. The petioles are also longer (3 to 4 cm). The short male catkins in winter are dark chocolate in color. These trees flowered in late January, 1981, a month earlier than the Tokyo tree.

Alnus inokumae was described as recently

as March 1962 by Murai and Kusaka but previously was known in various Japanese botanical publications under the names of *A. tinctoria* var. *microphylla,* and *A. hirsuta* var. *microphylla.* It has a rather scattered natural distribution in Japan, from central and northern Honshu to several stations in Hokkaido and even up into southern Sakhalin. This fast-growing tree appears to be capable of attaining 80 to 100 feet or even more in the wild state. Its distinguishing characters include the buds and the young shoots which are densely hairy. The leaves are broadly ovate, 6.5 to 9 cm long, 5.5 to 8.5 cm wide, shortly acuminate at the tip, broadly cuneate to rounded at the base, with a margin both lobulate and serrulate. The leaves are pubescent on both sides but more so beneath, especially on the veins; the petioles, 1 to 2 cm long, are also pubescent. The male catkins are slender, cylindrical, 2 cm long (in October), with peduncles and pedicels densely pubescent. The female cones are 1.3 to 1.7 cm long when nearly mature.

Professor Murai included seeds of this new species with those of the other three species sent to the Arboretum in February 1963; these had been collected the previous October in Aomori Prefecture in extreme northern Honshu. From them were grown three plants, set out when about 5 feet tall on Foster's Island in December 1965, in the meadow just across the bridge. They all grew well and by November 1981 the largest tree was 48 feet in height. Three more plants of *A. inokumae* were placed in another less well drained site on the Island in January 1966; the largest of these is now only 37 feet tall. In December 1968 a further three, 19 to 22 feet tall, were planted near the backwater from Lake Washington, below and north of East Foster's Island Road. One of these was damaged by vandals the following July and had to be replaced in January 1970. By December 1981 the largest tree in this group had attained 53 feet, perhaps because the site is more shaded than that of the first group planted on Foster's Island. Finally, two more young trees went to a location in the main collection between Azalea Way and Lake Washington Boulevard, in March 1969, when 17 to 21 feet tall. The largest of these is now 39 feet. *Alnus inokumae* seems to be settling down and growing rapidly under our conditions.

Elegant male catkins of *Alnus inokumae*.
Photo: B.O. Mulligan

HYBRIDS

Like other kinds of trees whose female flowers are fertilized by wind-blown pollen (e.g. the conifers, birches and walnuts) hybrids can be expected when seeds are taken from individual alders having other species growing near them. This may take place either in the wild or under cultivation. Hybrids between the European species *Alnus cordata* and *A. glutinosa,* and between *A. glutinosa* and *A. incana,* have been known since the early years of the 19th century. Other hybrids have been found as wild plants both in British Columbia, in the U.S.A., and in Japan. Hybrids are possible wherever the ranges of two species or subspecies overlap, as do those of *A. viridis* subsp. *crispa* and *A. viridis* subsp. *sinuata* in Alaska and the Yukon Territory. *Alnus japonica* and *A. hirsuta* form hybrids in Japan. Altogether about thirteen hybrids have been described since 1825.

Examples of three hybrids are to be found in

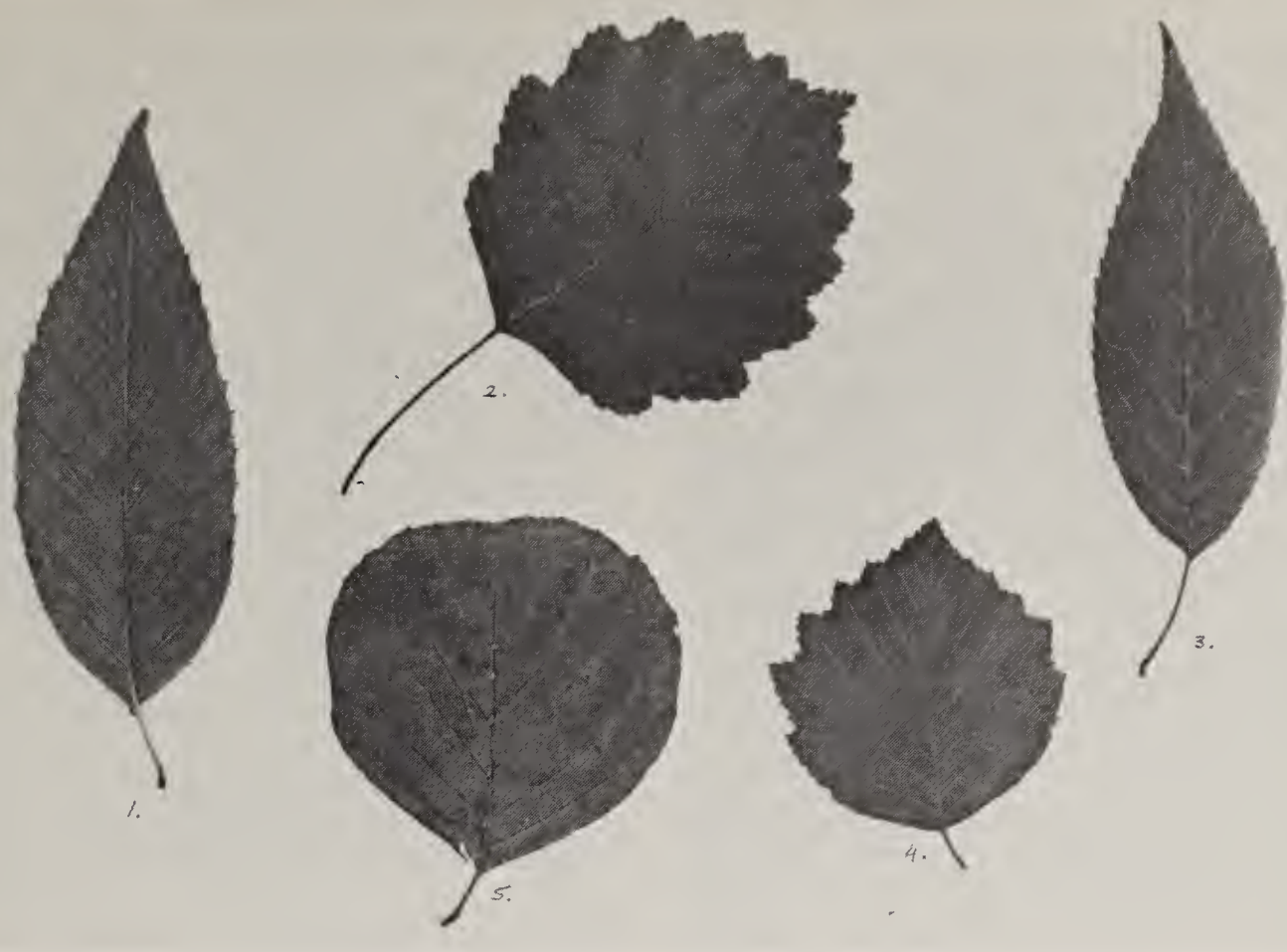
the Arboretum's collection. In February 1957, scions of *Alnus* x *spaethii* and *A.* x *spectabilis* were received from Highland Park, Rochester, N.Y. These were propagated by grafting onto seedlings of *A. rubra.* The trees were grown on for two years in the lath house and nursery and a plant of each was then set out on Foster's Island in December 1959. The young tree of *A.* x *spaethii* flowered a month later and has done so rather regularly in January each year thereafter. The male catkins are distinctly ornamental at that usually dull season of the year. They are produced in clusters of 6 to 10, up to 18 to 20 cm long, especially on young trees. (They are illustrated on the cover of the *Arboretum Bulletin,* Spring 1967.) The tree of *Alnus* x *spaethii* is now 36 feet tall. Another planted in the main collection in January 1960 has done even better; it is now 38 feet in height after 21 years growth. The trunk forks about 10 feet above the ground, the branches then arching rather gracefully.

Alnus x *spaethii* originated as a natural hybrid between *A. japonica* and the Caucasian-Iranian *A. subcordata,* in the arboretum of the Spath nursery near Berlin, in 1908. The young shoots are pubescent. The ovate-lanceolate leaves, purplish when young, are 12 to 14 cm long by 5 to 6.5 cm wide. Their size places them amongst the largest of the alders in the collection here. The leaf tip is acuminate, the base rounded, the margin doubly serrate. The leaves are pubescent above when young but beneath only in the axils of the 10 to 11 pairs of veins. The petiole is slender, curved at the base, 1.5 to 2.3 cm long. The mature female cones are barrel shaped, 2.3 to 2.5 cm long, and chocolate brown. In mid-November, 1981, the leaves were still retained on the second tree!

Alnus x *spectabilis,* considered to be a natural hybrid between *A. incana* and *A. japonica*, appeared in a German arboretum prior to 1906 when it was first described. The tree planted on Foster's Island in December 1959 is now only 23 feet in height. However, another of two planted April 1960 in the main collection is now up to 36 feet, dbh 11 inches, so that it has behaved similarly in that site to *A.* x *spaethii,* The male flowers open about a month earlier than those of *A.* x *spaethii,* often in December; the catkins are shorter, mostly 5 to 10 cm long. The leaves are ovate, acuminate at the tip, rounded at the base, 8 to 10 cm long, 5 to 7.5 cm wide, irregularly and slightly lobulate and also serrulate along the margins, glabrous above, pubescent beneath, especially on the 7 to 8 pairs of pale brown veins. The petioles are slender, 2.5 to 4 cm long and thinly pubescent, as are the young shoots. The cones occur up to four per cluster, tapering upwards, 2.4 to 2.8 cm long. The habit of the tree is distinctly pyramidal, widest at the base and with the branches angling upwards. In foliage *A.* x *spaethii* shows much more resemblance to *A. japonica* than does *A.* x *spectabilis;* both are handsome trees when bearing heavy loads of catkins in mid-winter.

The third hybrid is *Alnus* x *mayrii (A. hirsuta* x *A. japonica),* found wild in both Japan and Korea wherever these two species meet. In the north (Hokkaido) the cross is between *A. japonica* var. *arguta* and *A. hirsuta* var. *hirsuta* (or var. *sibirica),* and in the southern part of Japan and Korea between *A. japonica* and *A. hirsuta* var. *tinctoria.* The three plants now in the Arboretum came from the USDA Plant Introduction Station, Glenn Dale, MD., in April 1968. They had been raised from seeds collected at Suwon, Korea. The saplings were planted out in January 1972 when 10 feet tall in the alder grove north of and below the East Foster's Island road. By November 1981 they had attained 20 to 25 feet but were much drawn up by neighboring large old willow trees. At the present time it is not possible to form any reasonable opinion of their growth capabilities or ornamental or other values. However, hybrids of this parentage are considered to have good growth rates in Japan. In the Arboretum nursery there are two plants raised from seeds collected near Seoul, Korea by Professor Emeritus W.R. Hill of the University of Washington. These plants may also prove to be this hybrid. In October 1981 they were 6 feet in height.

In the nursery also are three young alder plants named *A. fruticosa,* now 7 to 9 feet in height. These were raised from seeds received in 1970 from the Botanical Garden of the Academy of Sciences of Czechoslovakia at Prague, but which had been collected on Sakhalin Island north of Japan. This species, which is uncommon in cultivation, is native to



A comparison of the leaves of Japanese alders: 1) *Alnus firma*, 2) *A. hirsuta*, 3) *A. japonica*, 4) *A. inokumae*, 5) *A. fauriei*
Photo: U.W. IMS Production Services

northeastern Asia in the USSR and is also found in north Korea but not in Japan. It is very closely related to the green alder of Europe *(A. viridis)*, both being shrubs growing 8 to 10 feet tall, with smooth brown shoots and small ovate finely serrate leaves, pubescent only in the vein axils on the underside. In these plants the leaves are rounded to subcordate at the base, serrulate, with 8 to 9 pairs of veins. The blades are generally 4.5 to 5.5 cm long, 3.5 to 4.5 cm wide. The petioles are firm, 7 to 12 mm long. The mature cones are ovate-oblong, usually 4 to 5 in each cluster, 1.0 to 1.4 cm long, on pedicels 5 to 7 mm long. Information about this plant is extremely scarce, although Rehder's *Manual* states that it was introduced in 1888. Its behaviour here will have to be observed and the plants compared with those of *A. viridis* from Switzerland.

Conclusions

To summarize our experiences with these various kinds of alders from all over the temperate zones of the world, which have been observed for periods ranging up to thirty or even more years in some cases, we can recommend the Italian *(A. cordata)*, the Japanese *(A. japonica)* and the common European *(A. glutinosa)* alders as fast growing trees, with the eastern Asiatic *A. hirsuta* and *A. inokumae* as also promising for the same purposes. Experience with the native American *A. rhombifolia* and *A. oblongifolia* and the Mexican *A. jorullensis* has regrettably been

TREES OF *ALNUS* IN THE ARBORETUM
November, 1981

Species	Acquisition No.	Height (feet)	D.B.H. (inches)
(In main collection west of Azalea Way and Rhododendron Glen)			
A. cordata (n.e. tree)	592-64	59	11
A. cordata (s. tree)	592-64	51	9
A. rhombifolia	234-56	52	15
A. hirsuta	328-51	46	11
A. japonica var. *arguta*	82-63	31	7
A. japonica	383-57	33	11
A. x *spectabilis*	205-57	36	11
A. inokumae (n. tree)	81-63	39	9
A. glutinosa	411-64	45	12
A. x *spaethii*	204-57	38	12
A. glutinosa	505-58	52	17
A. rubra 'Pinnatifida'	560-51	46	11
(On north side of Rhododendron Glen)			
A. cordata	56-51	67	16
A. japonica (formosana)	354-58	65	11
(On Foster's Island)			
A. cordata	1261-49	70	15
A. japonica (n. tree)	926-45	58	15.5
A. inokumae (s.e. tree)	81-63	48	9.5
A. inokumae (w. tree)	81-63	47	9
A. glutinosa	382-46	48	23
(North of E. Foster's Island Drive near Lagoon channel)			
A. inokumae (s.w. tree)	81-63	53	8.5
A. rubra (native tree)		86	20
A. rubra (native tree)		82	15
(Across E. Foster's Island Drive from Broadmoor gate)			
A. rubra (large tree in center of slope)		59	23

too sparse or too short to give us adequate evidence of their adaptibility or uses here, though *A. rhombifolia* at least should behave and grow well under our local conditions.

Amongst the smaller, more shrubby types of alder, the Japanese *A. firma* and *A. sieboldiana* can certainly be recommended for their distinctive, hornbeam-like foliage, the compact habit of growth and their quite noticeable flowering characteristics. Of the few hybrids tried here, both *A.* x *spaethii* and *A.* x *spectabilis* have merit for their profuse and showy flowering in mid-winter, the one earlier than the other, and differing in their growth forms and foliage. They can easily be propagated by grafting onto our native red alder, and it would be desirable to do so also with the attractive cut-leaved form of *A. glutinosa,* 'Imperialis', which, especially for wet sites, has considerable ornamental value.

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Book Reviews

GREEN THOUGHTS: A WRITER IN THE GARDEN, by Eleanor Perenyi. Random House, New York, 1981. 270 pages, line drawings, index. Price $15.50.

Green Thoughts is an unusual book in both format and content. Only the alphabet indicates the sequence of subjects from "Annuals" to "Woman's Place." Such subjects as "Earthworms" and "Endive" in juxtaposition need not startle us for we have already passed "Belgian Fence" followed by "Biennials". Some titles introduce mere paragraphs while others head more ambitious chapters. There is also an addendum devoted to "Catalogues".

The successful amalgamation of the subject matter is achieved by Eleanor Perenyi, who is primarily a writer with a scholarly background. She is a garden lover but not a specialist addicted to an individual category, and is an intense person whose devotion to diverse activities excites admiration. Whimsical prejudices as well as factual reasons govern her approach to gardening and the presence of both of these imbues her writing with fascination.

The Foreword mentions two gardens which have figured in the life of this vibrant woman who seems to have two compulsions in her life, to write and to garden. She says she does not want to pass herself off as a horticulturist, but thirty years of amateur experience provide the background for her observations on a wide range of subjects. She lists four encyclopedias as her references and she has evidently consulted them thoroughly. The present garden is described as a "labor-intensive" one. The backportion of the book jacket shows Mrs. Perenyi seated on a bench in one of her gardens, an unusual woman in the setting about which she writes.

A glance at the front portion of the book jacket may cause one to wonder whether the design is based on a real tree or is a figment of imagination. One must read the chapter on "Tree Houses" to find an answer.

While readers may disagree slightly or even vehemently with the opinions of the author, they must admire the depth and clarity of her thinking. She airs her views and even her prejudices candidly, discusses superstitions and scientific facts with equal interest, and makes observations at once helpful and amusing.

She is a staunch devotee of composting whereby one can give back to the soil what has been taken away. A succinct quotation states her opinion: "You can't buy compost. Neither can a healthy, well-conducted garden do without it." The implication is that compost must be made and must be used generously.

The section on herbs treats a fair representation from this classification. Most of the herbs discussed are culinary, indicating that being a superior gourmet cook is another facet of the author's life.

"Naturalizing" may be a good word to indicate the use of indigenous plants, but Mrs. Perenyi objects to "the idea that only a replica of the wilderness can qualify as an ecologically sound environment." If you follow the intricate twists of her thinking you may alter your own approach to landscaping.

Gardeners who have great respect for useful insects will enjoy the discussion of "the balance of nature" in the chapter on pests and diseases where we find these assertions: "Ladybugs are a boon" and "Wasps are, in fact, one of our more valuable allies owing to their parasitic habits." The use of chemicals

in the garden is viewed with skepticism.

Here is a book for easy reading and great enjoyment, one which treats a dizzying number of topics. The author is a well-organized worker whose insatiable curiosity has led her down many paths, and she has unearthed much practical wisdom which she shares in a delightful manner. We find ourselves drawn by Mrs. Perenyi to seek paths of gardening endeavor similar to those she has chosen. Thus may we experience the stimulating reward of discovery or re-discovery of many successful growing methods which we had overlooked. This is a book for easy reading and great enjoyment, and one to be kept available for ready reference.

FRANCES K. ROBERSON

THE COMPLETE BOOK OF ROSES, by Gerd Krussman. Timber Press, Portland, Oregon, 1981. 436 pages, 159 illustrations. Hard cover. Price $50.00.

In 1974, the world heralded the most complete volume on roses to be published in over 100 years, i.e. Krussman's *Rosen, Rosen, Rosen.* Since its language was German, it gained little acceptance in the English-speaking world except as a collectors' item. At last the volume has been translated into English, with the addition of American terminology as well as new knowledge. Although the untimely passing of Krussman slowed the translation process, it was finally completed by Nigel Raban. Now, through the cooperation of Timber Press and the American Horticultural Society, the English-speaking world is privileged to have this new classic.

The volume is more than a complete book on roses. It encompasses the entire knowledge and the love of roses which Krussman had. Every conceivable aspect of this flower has been meticulously researched by Krussman, and in the American version by additional authors.

The volume begins with a study of the history of roses, from rose fossils, through rose cultivation in classical and modern times, to the use of roses in language, myth and legend. In each era, the author shows the significance of the rose and how its early ancestors were important in today's continuing search for the perfect rose.

The volume is written in short chapters, making the information concise and easy to locate. The author is careful to arrange each section chronologically and he lists the important roses associated with each era. Each chapter ends with a concise bibliography.

There are chapters on roses once cultivated in specific countries such as France, Germany, China, and Japan. The beginning of hybridization is described for various countries. The genetic history of shrub roses, old garden roses and modern roses is presented in detail.

For those who desire cultural information, there are chapters on grafting, budding and various cultivation techniques. The recently updated chapters on all rose diseases, insects, and viruses make this a very current volume, something often difficult in a book of this size.

The rose societies and rose gardens of eighteen countries are described. There is also a short biography of leading rose breeders and a list of companies dealing in roses. For those interested in breeding roses, there are chapters on the theory and practice of hybridization, on rose genetics and on the principles of heredity.

The uses of roses are also described, in medicine, in the kitchen, on coins, as symbols, in attar, in art, as national emblems, in the church and in love-lore. Truly, the art as well as the science of the rose is documented in the volume. It is difficult to believe that one flower has touched so many aspects of our cultural development.

The concluding 123 pages of the volume comprise "The Dictionary of Rose Cultivation." This section contains complete descriptions of all commercial varieties, "old garden roses," wild roses, and most of the new American, British and African modern roses. The descriptions give the breeder, year of introduction, pedigree, height, and flower characteristics, as well as the American National Rating of garden value.

This is a volume which should answer any questions you may have about roses. For those interested in the history and breeding of roses, it is a must. For any others who are interested in roses, whether from an economic, culinary or esthetic viewpoint, it would be difficult to pass it by. If we must wait another hundred years for a new volume, this one will surely remain a classic.

JOHN A. WOTT

THE ENGLISHWOMAN'S GARDEN, edited by Alvilde Lees-Milne and Rosemary Verey. Chatto & Windus, London, 1980. 156 pages, 200 color photographs. Price $24.95.

This book was written by a number of English women gardeners and therefore is difficult to review. Each of the authors has her own ideas of landscape design and use of plant material, and many of them initially had help from their husbands in planning the gardens. While most of the gardens are large (of some acres) and well-established, others have been torn apart and reorganized. Stone and brick walls have been retained, and hedges of various conifers, clipped yews and topiary have been kept to great advantage. Old kitchen gardens with their surrounding walls acting as windbreaks, have been transformed into herb gardens, gardens of fragrant plants or paved and sunken gardens. Pool and water gardens of great appeal frequently have been created. Vines, shrubs and climbing roses trained over fences or against walls or up trees are used to enhance the landscape. The smaller town and cottage gardens are also described, and it is in the latter that the old-fashioned plants are found and preserved.

Many of the authors delight in showing friends and others around their gardens; most of these gardens are open to the public at certain times.

There are over 200 splendid color photographs illustrating the thirty-six gardens in this excellent book, and at the head of each chapter is a drawing of the particular house or of a part of its garden. It is a pleasure to read this book because of the enthusiasm of its authors. To end with a quotation from one lady, "It is not a good idea to find a place for a plant; it is much better to buy a plant for a place!"

MARGARET MULLIGAN

Joseph Witt Receives Public Service Award

Professor Joseph A. Witt, Curator of Plant Collections at the Washington Park Arboretum, Center for Urban Horticulture, received the 1982 Outstanding Public Service Award from the University of Washington Alumni Association at Commencement exercises in June. An honorarium of $2500 accompanied the award. Witt was cited for his administrative leadership in the Arboretum, his abilities as a teacher, and for his devotion to community service.

Professor Witt's friends and colleagues join in congratulating him on this exceptional recognition.

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Thirteenth Annual Fall Bulb Sale

Wednesday and Thursday, October 6 and 7, 10 AM-5 PM
Arboretum Administration Building Parking Lot

Fawn-lily, *Erythronium*. **Photo: D. Normark**

The Arboretum Foundation's bulb event for 1982 features over 350 varieties of bulbs from around the world. There will be bulbs for pots and planters, bulbs for borders and rock gardens. In addition to favorite narcissus and tulips and crocus for fall and spring, remember anemones and special small bulbs for tucking in secret corners. The woodland bulbs—*Erythronium* and *Trillium*— are lovely in partial shade. Varieties new this year include iris of England, Spain and the Netherlands, ten colors of the Japanese *Iris kaempferi*, and bearded dwarfs in dainty shades. There will be freesias for early forcing, and lilies for bloom through the summer.

Don't miss this chance to learn hyacinth-forcing and tulip-potting from the experts. (Bulb lists will be mailed after Labor Day.)

Join the Explorers' Walks meeting at 10 AM, Wednesday, August 25 and September 29, and Tuesday, October 12, in the Arboretum Administration Building Parking Lot. PLEASE WEAR ADEQUATE FOOTGEAR, even in warm weather.